

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re REISSUE application of)
U.S. Patent No. 6,117,700)
Applicant: Kenji ORITA et al.) **Box Reissue**
Issued: September 12, 2000)
For: METHOD FOR FABRICATING)
SEMICONDUCTOR DEVICE)
HAVING GROUP III NITRIDE)

PRELIMINARY AMENDMENT
37 CFR 1.173(b), (c)

Commissioner for Patents
Washington, D.C. 20231

Sir:

Please preliminarily amend the above-identified application as follows:

In the Claims:

Please add new claims 16-43 as follows:

16. A method for fabricating a semiconductor device, comprising the steps of:
 - a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate; and
 - b) applying RF power on the semiconductor layer, thereby making the conductivity type of the semiconductor layer p-type.
17. The method of Claim 16, wherein the step b) is conducted in an ambient of plasma.

18. The method of Claim 16, wherein the step b) is conducted with the temperature of the substrate kept at about 600°C or lower.

19. The method of Claim 18, wherein the step b) is conducted in an ambient of plasma.

20. The method of Claim 19, wherein the plasma comprises nitrogen plasma.

21. The method of Claim 16, further comprising the step of c) forming a p-side electrode out of a metal on the semiconductor layer after the step b) has been performed.

22. The method of Claim 21, wherein the step c) comprises annealing the p-side electrode at about 400°C or lower after the p-side electrode has been formed.

23. The method of Claim 22, wherein the step c) comprises exposing the semiconductor layer to a plasma after the p-side electrode has been formed.

24. The method of Claim 16, wherein the dopant is selected from the group consisting of magnesium, zinc, calcium, strontium, beryllium, cadmium, mercury and lithium.

25. A method for fabricating a semiconductor device, comprising the steps of:

- a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate;
- b) forming a p-side electrode out of a metal on the semiconductor layer; and
- c) applying RF power on the semiconductor layer, thereby making the conductivity type of the semiconductor layer p-type.

26. The method of Claim 25, wherein the step b) is conducted with the temperature of the substrate kept at about 600°C or lower.

27. The method of Claim 25, wherein the metal is selected from the group consisting of nickel, iron, copper, chromium, tantalum, vanadium, manganese, aluminum, silver, palladium, iridium, gold or platinum.

28. The method of Claim 25, wherein the metal is a hydrogen-storing metal selected from the group consisting of titanium, magnesium, calcium, zirconium, lanthanum, niobium, vanadium, nickel, iron, manganese, cobalt, chromium and aluminum.

29. The method of Claim 25, wherein the step b) comprises forming a hydrogen-absorbing layer out of a hydrogen-storing metal on the semiconductor layer before the p-side electrode is formed.

30. The method of Claim 29, wherein the hydrogen-storing metal is selected from the group consisting of titanium, magnesium, calcium, zirconium, lanthanum, niobium, vanadium, nickel, iron, manganese, cobalt, chromium and aluminum.

31. The method of Claim 25, wherein the step c) is conducted in an ambient of plasma.

32. The method of Claim 31, wherein the ambient of plasma comprises nitrogen plasma.

33. A method for fabricating a semiconductor device, comprising the steps of:
a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate; and
b) after introducing the substrate into a vacuum chamber, charging plasma into the vacuum chamber to form an ambient of plasma while keeping the temperature of the substrate at about 600°C or lower, thereby making the conductivity type of the semiconductor layer p-type.

34. The method of Claim 33, wherein the ambient of plasma comprises nitrogen plasma.

35. The method of Claim 33, further comprising the step of c) forming a p-side electrode out of a metal on the semiconductor layer after the step b) has been performed.

36. The method of Claim 35, wherein the step c) comprises annealing the p-side electrode at about 400°C or lower after the p-side electrode has been formed.

37. The method of Claim 36, wherein the step c) comprises exposing the semiconductor layer to a plasma after the p-side electrode has been formed.

38. The method of Claim 33, wherein the dopant is selected from the group consisting of magnesium, zinc, calcium, strontium, beryllium, cadmium, mercury and lithium.

39. A method for fabricating a semiconductor device, comprising the steps of:
a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate;
b) forming a p-side electrode out of a metal on the semiconductor layer; and
c) after introducing the substrate into a vacuum chamber, charging plasma into the vacuum chamber to form an ambient of plasma while keeping the temperature of the substrate at about 600°C or lower, thereby making the conductivity type of the semiconductor layer p-type.

40. The method of Claim 39, wherein the metal is selected from the group consisting of nickel, iron, copper, chromium, tantalum, vanadium, manganese, aluminum, silver, palladium, iridium, gold or platinum.

41. The method of Claim 39, wherein the metal is a hydrogen-storing metal selected from the group consisting of titanium, magnesium, calcium, zirconium,

lanthanum, niobium, vanadium, nickel, iron, manganese, cobalt, chromium and aluminum.

42. The method of Claim 39, wherein the step b) comprises forming a hydrogen-absorbing layer out of a hydrogen-storing metal on the semiconductor layer before the p-side electrode is formed.

43. The method of Claim 42, wherein the hydrogen-storing metal is selected from the group consisting of titanium, magnesium, calcium, zirconium, lanthanum, niobium, vanadium, nickel, iron, manganese, cobalt, chromium and aluminum.

2025 RELEASE UNDER E.O. 14176

REMARKS

As of the date of the present preliminary amendment, U.S. Patent No. 6,117,700 to Orita et al. ('700 patent) from which the subject reissue application is based, issued on September 12, 2000 with claims 1 to 15. By the present preliminary amendment, claims 16 to 43 are added in the subject reissue application to claims 1 to 15. Claims 16, 25, 33, and 39 are independent claims while the remainder of the claims are dependent thereon. Explanations of the support in the disclosure for the added claims are provided herein below.

Claims 16 to 24 each claim a method for fabricating a semiconductor device, comprising the steps of a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate, and b) applying RF power on the semiconductor layer, thereby making the conductivity type of the semiconductor layer p-type. The support for the newly added claims 16 to 24 is found in the Specification of the '700 patent which describes forming of a semiconductor layer by applying RF power thereon. (See Col. 6 , lines 36-48).

Claims 25 to 32 each claim a method for fabricating a semiconductor device, comprising the steps of a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate, b) forming a p-side electrode out of a metal on the semiconductor layer; and c) applying RF power on the semiconductor layer, thereby making the conductivity type of the semiconductor layer p-type. The support for the newly added claims 25 to 32 is found in the Specification of the '700 patent which describes forming of a semiconductor layer by applying RF power thereon and forming of a p-side electrode. (See Col. 6 , lines 36-55; Col. 9, lines 13-31).

Claims 33 to 38 each claim a method for fabricating a semiconductor device, comprising the steps of a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate, and b) after introducing the substrate into a vacuum chamber, charging plasma into the vacuum chamber to form an ambient of plasma while keeping

the temperature of the substrate at about 600°C or lower, thereby making the conductivity type of the semiconductor layer p-type. The support for the newly added claims 33 to 38 is found in the Specification of the '700 patent which describes forming of a semiconductor layer and charging plasma after introducing the substrate into a vacuum chamber. (See Col. 6, lines 13-22, 28-40, 63-67).

Lastly, claims 39 to 43 each claim a method for fabricating a semiconductor device, comprising the steps of a) forming a semiconductor layer of a Group III nitride containing a dopant over a substrate, b) forming a p-side electrode out of a metal on the semiconductor layer, and c) after introducing the substrate into a vacuum chamber, charging plasma into the vacuum chamber to form an ambient of plasma while keeping the temperature of the substrate at about 600°C or lower, thereby making the conductivity type of the semiconductor layer p-type. The support for the newly added claims 39 to 43 is found in the Specification of the '700 patent which describes forming of a semiconductor layer, forming a p-side electrode out of a metal, and charging plasma after introducing the substrate into a vacuum chamber. (See Col. 6, lines 13-22, 28-40, 49-55, 63-67).

Correspondingly, no new matter is present by the above added claims and examination on the merits and issuance of the subject reissue application is respectfully requested.

Respectfully submitted,


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Dated: 10-13-01